

**U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM**

SCIENTIFIC NAME:

Pseudanophthalmus caecus Krekeler
Pseudanophthalmus frigidus Barr
Pseudanophthalmus parvus Krekeler
Pseudanophthalmus troglodytes Krekeler

COMMON NAME:

Clifton Cave beetle
Icebox Cave beetle
Tatum Cave beetle
Louisville Cave beetle

LEAD REGION: 4

INFORMATION CURRENT AS OF: March 17, 2010

STATUS/ACTION:

Species assessment - determined species did not meet the definition of endangered or threatened under the Act and, therefore, was not elevated to Candidate status

New candidate

Continuing candidate

Non-petitioned

Petitioned - Date petition received: May 11, 2004

90-day positive - FR date:

12-month warranted but precluded - FR date:

Did the petition request a reclassification of a listed species?

FOR PETITIONED CANDIDATE SPECIES:

a. Is listing warranted (if yes, see summary of threats below)? yes

b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? yes

c. If the answer to a. and b. is "yes", provide an explanation of why the action is precluded. Higher priority listing actions, including court-approved settlements, court-ordered and statutory deadlines for petition findings and listing determinations, emergency listing determinations, and responses to litigation, continue to preclude the proposed and final listing rules for the species. We continue to monitor populations and will change its status or implement an emergency listing if necessary. The "Progress on Revising the Lists" section of the current CNOR (<http://endangered.fws.gov/>) provides information on listing actions taken during the last 12 months.

Listing priority change

Former LP:

New LP: ____

Date when the species first became a Candidate (as currently defined): October 30, 2001

____ Candidate removal: Former LP: ____

____ A – Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.

____ U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.

____ F – Range is no longer a U.S. territory.

____ I – Insufficient information exists on biological vulnerability and threats to support listing.

____ M – Taxon mistakenly included in past notice of review.

____ N – Taxon does not meet the Act’s definition of “species.”

____ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Class Insecta, Order Coleoptera, Family Carabidae

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE:

Pseudanopthalmus caecus, Clifton Cave beetle - Kentucky

Pseudanopthalmus frigidus, Icebox Cave beetle - Kentucky

Pseudanopthalmus parvus, Tatum Cave beetle - Kentucky

Pseudanopthalmus troglodytes, Louisville Cave beetle - Kentucky

CURRENT STATES/ COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE:

Pseudanopthalmus caecus, Clifton Cave beetle – Woodford County, Kentucky

Pseudanopthalmus frigidus, Icebox Cave beetle – Bell County, Kentucky

Pseudanopthalmus parvus, Tatum Cave beetle – Marion County, Kentucky

Pseudanopthalmus troglodytes, Louisville Cave beetle – Jefferson County, Kentucky

LAND OWNERSHIP: All of the caves supporting these species are privately owned.

LEAD REGION CONTACT: Atlanta Regional Office, Rob Tawes 404-679-7142, robert_tawes@fws.gov

LEAD FIELD OFFICE CONTACT: Frankfort, Kentucky Field Office (KFO), Dr. Michael A. Floyd, 502/695-0468

BIOLOGICAL INFORMATION:

The insect genus *Pseudanophthalmus* is in the predatory ground beetle family Carabidae. Most members of this genus are cave dependent (trogllobites) and are not found outside the cave environment. All are predatory and feed upon small cave invertebrates such as spiders, mites, millipedes, and diplurans, while the larger *Pseudanophthalmus* species also feed on cave cricket eggs (Barr 1996, p. 6). Members of this genus vary in rarity from fairly common, widespread species that are found in many caves to species that are extremely rare and restricted to only one cave or, at most, two caves.

Cave beetles in the genus *Pseudanophthalmus* are fairly small, eyeless, reddish-brown insects. Like most other insects, they have six legs and a body that consists of a head, thorax, and abdomen. Body length is generally from 3.0 to 8.0 millimeters (0.12 to 0.32 inches). The different species within the genus are differentiated by differences in the shape and size of the various body parts, especially the shape of the male appendages used during reproduction. Barr (1996, p. 3) states that there are approximately 255 species in the genus *Pseudanophthalmus*.

Little detailed life history information is available for the rarest of the cave beetles that are considered here, but the generalized summary that follows is accurate for the more common and more easily studied species and is believed to also apply to the rarer species (Barr 1998, p. 3). Cave beetles copulate in the fall, and the eggs are deposited in the cave soil during late fall. The eggs hatch and larvae appear in late fall through early winter. Pupation occurs in late winter to early summer with the adult beetles emerging in early summer (Barr 1996, page 5).

The limestone caves in which these cave beetles are found provide a unique and fragile environment that supports a variety of species evolved to survive and reproduce under the demanding conditions found in cave ecosystems. No photosynthesis takes place within the dark zone of a cave. Therefore, all organisms that are adapted to life within a cave are dependent upon energy from the surface. This energy can be in the form of leaf litter, woody debris, or small bits of organic matter that is washed or falls into the cave, or guano deposited by cave-dependent bats that feed on the surface and return to the cave to roost (Barr 1996, pp. 6-7).

Pseudanophthalmus caecus, the Clifton Cave beetle, was described by Krekeler (1973, pp. 35-83) based upon material collected by T.C. Barr in 1963. The entrance to Clifton Cave is located approximately 8 kilometers (km) (5 miles [mi]) northwest of Versailles, Woodford County, Kentucky (Barr 1996, pp. 21-23). Soon after the species was first collected, the entrance to the cave was closed as a result of road construction activities along KY 1964 (Clifton Road). Other caves in the vicinity of Clifton Cave were surveyed for the species during a 1995/1996 survey by Barr (1996, pp. 21-23), and one additional site was discovered. Four specimens of *P. caecus* were found in a very small, 9-meter (30-foot) long, crawlway cave about 1.61 km (1 mi) northeast of Clifton Cave (Barr 1996, p. 23). It cannot be determined at this time if the species still occurs in Clifton Cave or if the species has been extirpated from its type locality by the closure of the cave entrance. Working cooperatively in October 2008, the Kentucky Transportation Cabinet, Kentucky State Nature Preserves Commission, and KFO attempted to reopen the

cave entrance to Clifton Cave. A backhoe was used to scrape away rock and dig along KY 1964, but the cave entrance was not located.

Pseudanophthalmus frigidus, the Icebox Cave beetle, was described by Barr (1981, pp. 86-87) based upon two specimens he collected from Icebox Cave, Bell County, Kentucky. Despite searches of caves in the vicinity of this cave and several later visits to Icebox Cave (Laudermilk 2006, p. 5), no additional specimens of Icebox Cave beetle have been found. The cave is frequently visited, but the trash-filled conditions reported by Barr (1996, p. 52) have improved (Laudermilk 2006, p. 5).

Pseudanophthalmus parvus, the Tatum Cave beetle, was described by Krekeler (1973, pp. 35-83) from material collected from Tatum Cave, Marion County, Kentucky. Despite searches in 1980, 1996, and 2005, the species has not been observed in Tatum Cave since 1965. The cave has three openings – a lower stream outlet, an intermediate sink with collapsed roof (karst window), and an upper sink that was probably artificially created. The upper sink has been reinforced with concrete pillars, and the artificial opening has been loosely sealed with timbers (Barr 1996, pp. 11-12). This additional entrance has modified air flow within the cave (warm air in summer, cold air in winter) and may have seriously impacted the Tatum Cave beetle population (Barr 1996, p. 12; Laudermilk 2006, p. 7). No other caves in the vicinity of Tatum Cave have been located that could support the species.

Pseudanophthalmus troglodytes, the Louisville Cave beetle, was described by Krekeler (1973, pp. 35-83) from specimens collected from Highbaugh Cave, Jefferson County, Kentucky. The entrance to Highbaugh Cave was closed during residential development activities in the early 1990s (Barr 1996, p. 42). In 1994, surveys of other caves in Jefferson County that could potentially support the species were conducted by Dr. Jerry Lewis (Barr 1996, pp. 41-44). Ten caves were surveyed, and the species was found (one female specimen) in one additional cave (Eleven Jones Cave). The entrance to Eleven Jones Cave is located along the right descending (southeast) bank of Beargrass Creek near the Louisville Cemetery. The cave was described by Barr (1996, p. 42) as a “narrow, mostly clean-washed hands-and-knees crawlway, locally known for its sometimes dangerously high carbon dioxide levels.” No additional survey efforts have been completed since that time (Laudermilk 2006 p. 7).

THREATS:

A. The present or threatened destruction, modification, or curtailment of its habitat or range.

These four cave beetles (Clifton Cave beetle, Icebox Cave beetle, Tatum Cave beetle, and Louisville Cave beetle) are currently known from only one or two caves. Their limited distributions make these species vulnerable to isolated events that would only have a minimal effect on the more wide-ranging members of the genus. Events such as toxic chemical spills, discharges of large amounts of polluted water, closure of entrances, alteration of entrances, or the creation of new entrances can have serious adverse impacts on these cave beetles and could result in their extinction (Barr 1996, pp. 9-10). Caves

and the species that are completely dependent upon them (troglodites) receive the energy that forms the basis of the cave food chain from outside the cave. This energy can be in the form of bat guano deposited by cave-dependent bats, large or small woody debris washed or blown into the cave, or tiny bits of organic matter that is carried into the cave by water through small cracks in the rocks overlying the cave (Barr 1996, pp. 6-7). Activities such as industrial, residential, commercial, or highway construction can, if not planned in a manner to protect caves, directly destroy caves or result in severe modification of the natural processes that maintain the sensitive biological systems they support. Pollution and chemical contamination can, under certain circumstances, result in the complete destruction of the unique life found within a cave impacted by these factors. Vandalism and trash dumping have affected some of the sites, and all of the caves are vulnerable to these activities. Loss or reduction of the supply of energy can result in the loss or severe reduction of cave beetle populations (Barr 1996, pp 16-17).

Many of these fragile caves have been adversely impacted. The entrance to Clifton Cave was enclosed due to road construction. Icebox Cave is within the city limits of Pineville, Kentucky, and is frequently visited, heavily vandalized, and contains a lot of trash. Tatum Cave has three natural entrances and an additional entrance has been created in order to use the cave as a water supply (Barr 1996, p. 11). This additional entrance has modified air flow within the cave and may have seriously impacted the Tatum Cave beetle population. Oxmoor and Eleven Jones Caves are both within the Louisville, Kentucky, metropolitan area. Urban expansion has resulted in the loss of Oxmoor Cave. In about 1990, the entrance to the cave was bulldozed shut and a residential subdivision was built over the area. Eleven Jones Cave is a small cave that sometimes has high levels of carbon dioxide (Barr 1996, p. 42). These elevated carbon dioxide levels may be related to high levels of pollution in the water entering the cave.

Dependence upon the surface makes caves and the life found within them vulnerable to actions that take place well outside and away from the cave. Protection of caves and cave dependent species must include both the physical environment in which the species are found and the surface components that provide the energy and clean water needed for survival.

B. Overutilization for commercial, recreational, scientific, or educational purposes.

All of these cave beetles occur at only one or two locations. Most populations are extremely small and careless collecting, whether for scientific or other purposes, could adversely affect them. These species have no known commercial value, however, the caves in which these species occur may be used for recreational purposes by cavers and by casual cave visitors.

C. Disease or predation.

Disease or predation is not known to be a significant problem for any of these species. However, since each species appears to exist with low numbers of individuals, mortality via either of these two factors may have a significant, negative impact on recruitment and long-term survival.

D. The inadequacy of existing regulatory mechanisms.

These species are not protected under Kentucky or Tennessee state law.

E. Other natural or manmade factors affecting its continued existence.

Populations of each of these cave beetle species are restricted in distribution and are generally believed to be represented by small numbers of individuals. These characteristics make them extremely vulnerable to extirpation from (1) intentional or accidental toxic chemical spills, (2) non-point source pollutants, (3) alteration or closure of cave entrances that disrupt the natural flow of organic matter and can alter natural temperature and hydrologic regimes, and (4) excessive human disturbance (e.g., trampling, vandalism, building fires). Their small size and cryptic behavior also make them difficult to study, further complicating attempts at conservation. Small population sizes for these species limit the natural interchange of genetic material within each population. Unfortunately, it is possible that some of these beetle populations are below the effective population size required to maintain long-term genetic and population viability.

CONSERVATION MEASURES PLANNED OR IMPLEMENTED:

The Kentucky Department of Fish and Wildlife Resources (KDFWR) in cooperation with the Service funded a status survey for the rarer cave beetles that occur in Kentucky (Barr 1996, pp. 1-63). A part of this survey included identification of owners of the caves supporting these species. In gathering the land ownership information needed for the final report on this cooperatively funded project (Barr 1996, pp. 11-55), the landowners were made aware of the presence of the rare cave beetles within caves on their land. In general, landowners were supportive of protecting these rare species. In 2008, the KSNPC secured an agreement from the Tatum Cave owners that added the site to the State's Natural Areas Registry Program. The KSNPC is evaluating options to restore the microclimate in Tatum Cave by closing the artificial entrance (upper sink) to the cave (E. Lauder milk, pers. comm., 2009).

Most of the owners of sites on which these cave beetle caves occur were contacted by Dr. Barr or those assisting him with survey activities to determine the status of these species. Most owners were pleased to learn of the presence of a rare species within their caves and are expected to be willing to assist with any protection activities needed to protect and recover these cave beetles. The KDFWR actively participated in gathering the information presented in Barr (1996, p. 60; 1998, p. 1) on the status of these species. It is anticipated that they will continue to support and participate in rare cave beetle protection.

Upon review of a draft of this assessment, Dr. Tom Barr (2010, pers. comm.) recommended several conservation actions for these cave systems. For Tatum Cave, he recommended that the upper opening be closed. He believes Clifton Cave should be reopened and gated. For Icebox Cave, he recommended gating but thought the cave gate would likely be vandalized. In lieu of a cave gate, Dr. Barr recommended that wood be

added in wet areas of the cave to provide habitat and energy inputs for the Icebox Cave microecosystem.

SUMMARY OF THREATS:

These four cave beetles are currently known from only one or two caves. Their limited distributions make them vulnerable to isolated events that would only have a minimal effect on the more wide-ranging members of the genus. Events such as toxic chemical spills, discharges of large amounts of polluted water, closure of entrances, alteration of entrances, or the creation of new entrances can have serious adverse impacts on these cave beetles and could result in their extinction. We find that these species are warranted for listing throughout all their ranges, and, therefore, find that it is unnecessary to analyze whether they are threatened or endangered in a significant portion of their ranges.

RECOMMENDED CONSERVATION MEASURES:

Maintain/establish landowner contact. Establish/maintain conservation agreements or memoranda of understanding to ensure appropriate management of caves supporting these species. Construct gates or other appropriate barriers to control human access when necessary. Monitor population levels annually and search for additional populations. Monitor existing threats to these species and to the caves that support them. Develop and implement plans to reduce or eliminate direct and indirect threats to these species. Continue annual review of the status of these species.

LISTING PRIORITY

THREAT			
Magnitude	Immediacy	Taxonomy	Priority

High	Imminent	Monotypic genus	1
		Species	2
		Subspecies/population	3
	Non-imminent	Monotypic genus	4
		Species	5*
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:

Magnitude: All of these cave beetles are currently known from only one or two caves. Their limited distributions make them vulnerable to isolated events that would only have a minimal effect on the more wide-ranging members of the genus. Events such as toxic chemical spills, discharges of large amounts of polluted water, closure of entrances, alteration of entrances, or the creation of new entrances can have serious adverse impacts on these cave beetles and could result in their extinction.

Imminence: The threats faced by these species are significant, however, it is not anticipated that they will be subject to these threats in the immediate future (next 1-2 years).

Yes Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed?

Is Emergency Listing Warranted? No. Given the current status and the magnitude and imminence of the threats to these species, emergency listing is not warranted at this time.

DESCRIPTION OF MONITORING

In fiscal year 2004, a cooperative agreement between the Kentucky State Nature Preserves Commission (KNSPC) and the Service funded a status survey of all formal candidate *Pseudanophthalmus* species in Kentucky. In 2005, KNSPC reported that there was no change in the status of the species and no new threats to their continued existence were identified during their surveys. A report on the KNSPC survey effort was produced in 2006 (Laudermilk 2006, pp. 1-15). The KFO plans to conduct surveys for all four beetles in summer/fall 2010.

COORDINATION WITH STATES

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment: Kentucky.

Indicate which State(s) did not provide any information or comments: N/A

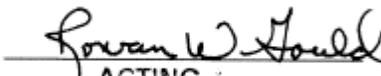
Kentucky did not include insects in its Wildlife Action Plan (KDFWR 2005); the only invertebrates included in the plan were freshwater mussels.

LITERATURE CITED

- Barr, Thomas C. 1981. *Pseudanopthalmus* from Appalachian Caves (Coleoptera: Carabidae): The Engelhardti Complex. *Brimleyana* 5: 37-94.
- Barr, Thomas C., 1996. Cave Beetle Status Survey and Prelisting Recovery Project. Unpublished Report to Kentucky Department of Fish and Wildlife Resources, Frankfort, Kentucky, and the U.S. Fish and Wildlife Service, Asheville, North Carolina. 63 pp.
- Barr, Thomas C. 1998. Study of Potentially Threatened or Endangered Species of Cave Beetles in Tennessee, Alabama and Georgia. Interim Progress Report to the Tennessee Wildlife Resources Commission. 11 pp.
- Barr, Thomas C. 2010. Personal communication, email from Tom Barr regarding potential conservation efforts for Tatum Cave, Clifton Cave, and Icebox Cave. Nashville, Tennessee.
- Kentucky Department of Fish and Wildlife Resources. 2005. Kentucky's Comprehensive Wildlife Conservation Strategy. KDFWR. Frankfort, Kentucky.
- Krekeler, C. H. 1973. Cave Beetles of the Genus *Pseudanopthalmus* (Coleoptera: Carabidae) from the Kentucky Bluegrass and Vicinity. *Fieldiana* 62(4):35-83.
- Laudermilk, Ellis L. 2006. A Survey for Kentucky *Pseudanopthalmus* (Coleoptera: Carabidae: Trichinae) Species Considered Candidates For Listing by the U. S. Fish and Wildlife Service. Kentucky State Nature Preserves Commission, Frankfort, Kentucky. 15 pp.
- Laudermilk, Ellis L. 2009. Personal communication to Robert Currie, Fish and Wildlife Biologist (retired), Asheville Field Office, US Fish and Wildlife Service. Asheville, NC. January 26, 2009.

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve: 
_____ June 14, 2010
for Regional Director, Fish and Wildlife Service Date

Concur: 
ACTING
Director, Fish and Wildlife Service Date: October 22,
2010

Do Not Concur: _____
Director, Fish and Wildlife Service Date

Director's

Remarks: _____

Date of annual review: March 2010

Conducted by: Kentucky Field Office, Dr. Michael A. Floyd, 502/695-0468, x102.